Biomass burning signatures in CO observed during CRYSTAL-FACE

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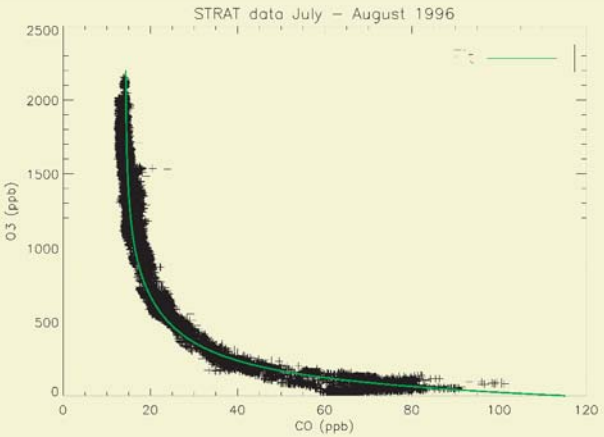
Abstract: Measurements of CO by the Argus laser spectrometer on the B-57 during the CRYSTAL-FACE (CF) campaign show clear biomass burning signatures on several flights. On July 7 and 9 we detected CO plumes (170-200 ppb near 15 km altitude) in the lower stratosphere at 380 K potential temperature. Trajectory analyses (Stohl *et al.*)indicate that the source of these plumes was probably forest fires over North America. Additional confirming evidence of the biomass burning source of the plumes is provided by the PALMS (Murphy *et al.*) instrument detecting enhanced K exactly coincident with the elevated CO plumes on those days. A multiple-layered CO plume seen on July 3 just above 7 km (400 mb) could be a biomass plume or enhanced CO transported upward from the nearby planetary boundary layer.

Figure 1



Quantitative evidence of generally enhanced CO at altitudes above 7 km early in the CF campaign , which is at least partly due to fires, is provided by a comparison with data from the STRAT 1996 campaign (see Herman *et al.*). CO and O3 data from STRAT are shown here (Figure 1) for several months at mid-latitudes. The (green) fit line on the plot is a non-linear least squares fit using a function that is the sum of a constant and 2 exponentials. The form of the correlation appears to be robust as the same fit function is in quite good agreement with data from the SONEX mission. (October-November 1997)

The STRAT fit function is here shown overplotted on the CF O3:CO correlation data (Figure 2). In addition to the very clear lower stratosphere plumes observed on July 7 and 9 there is generally enhanced CO relative to the fit line above 7 km on July 3, 7 and 9. This enhancement diminishes with time and totally disappears later in the CF flight series, by the 19th of July. Several of the late July CF correlation plots agree extremely well with the canonical correlation derived from STRAT.

Figure 2

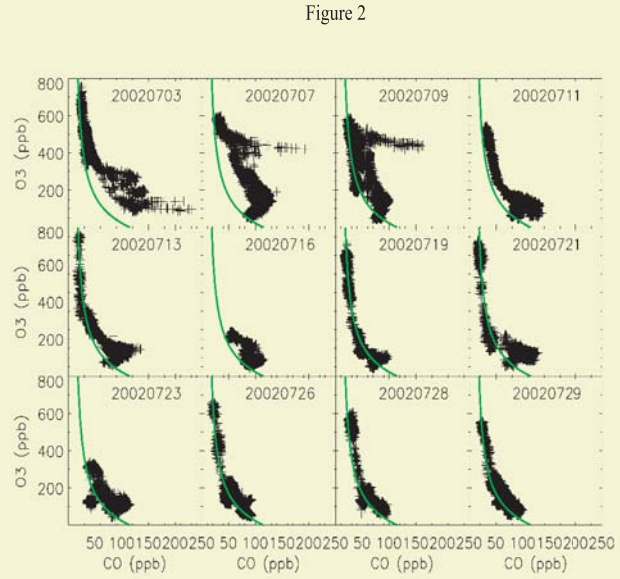
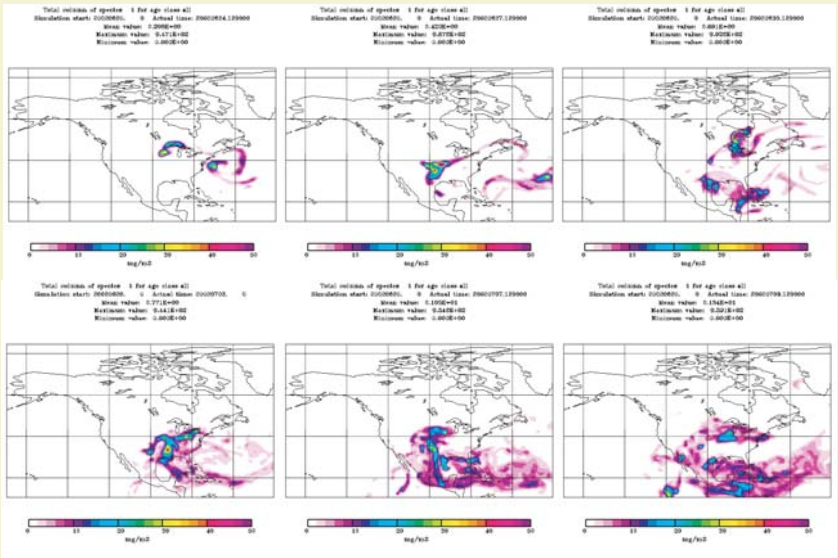


Figure 3



Forward trajectories computed by Stohl et al. are shown in this figure (Figure 3). The plume maps show locations of enhanced CO column amount in the 12 to 17 km layer of the lower stratosphere following eruptive fires over the continental US on June 24, 2002. These trajectories provide a strong argument supporting our conjecture that CO plumes observed on July 7 and 9 had their origin in fires over the continental US in late June. CO enhancements from biomass burning plumes in the UT/LS were previously observed by Waibel *et al.*

References:

Herman, R.L., C.R. Webster, R.D. May, D.C. Scott, H. Hu, E.J. Moyer, P.O. Wennberg, T.F. Hanisco, E.J. Lanzendorf, R.J. Salawitch, Y.L. Yumg, J.J. Margitan, T.P. Bui, Measurements of CO in the upper troposphere and lower stratosphere, *Chemosphere: Global Change Science, 1*, 173-183, 1999.

Waibel, A.E., H. Fischer, F.G. Wienhold, P.C. Siegmund, B. Lee, J. Strom, J. Lelieveld, P.J. Crutzen, Highly elevated carbon monoxide concentrations in the upper troposphere and lowermost stratosphere at northern midlatitudes during STREAM II summer campaign in 1994,

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